PB-230 673

WATER SUPPLY AND WATER QUALITY CONTROL STUDY, POTEAU RIVER BASIN, OKLAHOMA AND ARKANSAS. STUDY OF NEEDS AND VALUE OF STORAGE FOR MUNICIPAL AND INDUSTRIAL WATER SUPPLY AND WATER QUALITY CONTROL

Federal Water Pollution Control Administration
Dallas, Texas

September 1966

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB-230 673

WATER SUPPLY AND WATER QUALITY CONTROL STUDY POTEAU RIVER BASIN OKLAHOMA AND ARKANSAS

Study of Needs and Value of Storage for Municipal and Industrial Water Supply and Water Quality Control

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
South Central Region
Dallas, Texas
SEPTEMBER 1966

PB 230 673

WATER SUPPLY

AND

WATER QUALITY CONTROL STUDY

POTEAU RIVER BASIN

OKLAHOMA AND ARKANSAS

Abstract

A survey has been made which discloses a present and future need for storage in the Poteau River basin for municipal and industrial water supplies and for the control of water quality. These conclusions are based on results of economic and demographic studies.

Prepared for

DEPARTMENT OF THE ARMY

U.S. Army Engineer District

Tulsa, Oklahoma

COLOR ILLUSTRATIONS REPRODUCED
IN BLACK AND WHITE

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
South Central Region
Dallas, Texas

SEPTEMBER 1966

47

TABLE OF CONTENTS

		Page
LIST OF TABLES		iii
LIST OF FIGURES		iv
I.	INTRODUCTION	
	Request and Authority	I-1
	Purpose and Scope	I-1
	Acknowledgments	I-1
II.	SUMMARY OF FINDINGS AND CONCLUSIONS	
	Summary of Findings	II-1
	Conclusions	II-2
III.	PROJECT DESCRIPTION	III-1
IV.	STUDY AREA DESCRIPTION	
	Location and Boundaries	IV-1
	Characteristics	IV-1
V.	WATER RESOURCES OF THE STUDY AREA	V-1
	Streamflow	V-1
	Streamflow Quality	V-2
	Ground Water	V-3
VI.	THE ECONOMY	
	Present	VI-1
	Future	VI-4
VII.	WATER REQUIREMENTS - MUNICIPAL AND INDUSTRIAL	
	Past and Present Water Use	VII-1
	Future Requirements	VII-2

TABLE OF CONTENTS (Continued)

		Page
VIII.	WATER QUALITY CONTROL.	VIII-1
	Water Quality Objectives	VIII-1
IX.	BENEFITS	
	Municipal and Industrial Water Supply.	IX-1
	Water Quality Control.	IX-2
X.	BIBLIOGRAPHY	X-1
	APPENDIX	
	Summary of Alternative Cost Computations	1

LIST OF TABLES

Number	Title	Page
V-1	Chemical Analysis, Poteau River Basin.	V-2
VI-1	Study Area Population.	VI-1
VI-2	Agricultural Statistics for the Study Area, 1944 - 1959.	VI-2
VI-3	Manufacturing Activity in the Study Area, 1939 - 1958.	VI-4
VI-4	Study Area Labor Force and Population 1960 and 2025.	VI-7
VI-5	Population Projections to 2025 and 2075 for the Study Area, the Poteau Area, and Specified Cities	VI-8
VII-1	1963 Water Use in the Study Area	VII-1
VII-2	2025 and 2075 Municipal Water Demands, Poteau River Communities	VII-3
VII-3	Industrial Water Use Projections	VII-4
VII-4	Municipal and Industrial Water Supply Plan . . .	VII-4
VIII-1	Gross Water Quality Control Requirements, Poteau River below Wister Reservoir.	VIII-3
VIII-2	Gross Water Quality Control Requirements Waldron, Arkansas and Wilburton, Oklahoma. . .	VIII-4
VIII-3	Net Water Quality Control Draft-on-Storage Need, Poteau River Basin	VIII-2
VIII-4	Water Quality Control Monthly Release Schedule Wister Reservoir	VIII-5

LIST OF FIGURES

Number	Title	Following Page
III-1	Location Map.	X-2
V-1	Annual Mean Flow Frequency Poteau River below Wister Reservoir	V-2
V-2	Monthly Distribution of Annual Flow Poteau River below Wister Reservoir	V-2
VI-1	Resources	VI-3
VI-2	Possible Industrial Complex	VI-6

I. INTRODUCTION

Authority

In a letter dated March 23, 1962, the U.S. Army Engineer District, Tulsa, Oklahoma, requested that the Public Health Service* make an investigation to determine the need for and value of storage for water supply and water quality control in the Poteau River basin. The request asked that consideration be given to water requirements for a 100-year period.

This study has been done in accordance with (1) a Memorandum of Agreement between the Department of the Army and the Department of Health, Education, and Welfare, dated November 4, 1958, relative to Title III of the Water Supply Act of 1958, as amended; and (2) the Federal Water Pollution Control Act, as amended, (33 U.S.C. 466 et seq.).

Purpose and Scope

The purpose of this study is to determine the need for and value of storage for water requirements to the year 2075 for municipal, industrial, and water quality control purposes in the Poteau River basin. The study area includes Sequoyah, Haskell, Latimer, and LeFlore Counties, Oklahoma; and Crawford, Scott, and Sebastian Counties, Arkansas.

Acknowledgments

Appreciation is expressed to the following organizations who provided information and technical advice during the preparation of this report:

Corps of Engineers, Tulsa District Office
Various agencies within the U.S. Department of Agriculture
Oklahoma State Department of Health
Oklahoma Water Resources Board
Arkansas State Board of Health
Arkansas Pollution Control Commission
University of Oklahoma, Bureau of Business Research
Oklahoma State University, Department of Economics
University of Arkansas, Industrial Research and Extension Center of the College of Business Administration
Chambers of Commerce and various public officials of the municipalities in the study area

*In accordance with the Water Quality Act of 1965 (Public Law 89-234), approved October 2, 1965, the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.) is now administered through the Federal Water Pollution Control Administration.

II. SUMMARY OF FINDINGS AND CONCLUSIONS

Summary of Findings

1. The Corps of Engineers, Tulsa, Oklahoma is investigating the feasibility of enlarging the existing Wister Reservoir, and constructing Brazil Creek Reservoir in the Poteau River basin, for flood control, water supply and water quality control, recreation, conservation, and fish and wildlife purposes.

2. The study area consists of seven counties which encompass the Poteau River basin and can be characterized economically as the Fort Smith, Arkansas trade area. The area includes Sequoyah, Haskell, Latimer, and LeFlore Counties in Oklahoma; and Crawford, Sebastian, and Scott Counties in Arkansas.

3. The study area had a total population of 159,266 in 1960, of which 69,419 were classified as urban. Fort Smith, the largest municipality in the study area, had a 1960 population of 52,991. Its population had increased to 63,309 in 1962 when a special census was taken.

4. The major industrial use of water in the area is by the food and kindred industries, located primarily in Fort Smith. The numerous food processing firms obtain their water from the municipal systems, and thus their demand is a part of the total municipal water use figures. The 1963 urban water use in the study area amounted to 10.9 million gallons daily (mgd) serving about 100,000 persons with a daily per capita demand of about 109 gallons (gpcd). With minor exceptions, all municipal water supplies are obtained from surface sources.

5. Poteau River water is of exceptionally good quality, containing very low concentrations of chlorides, sulfates, and dissolved solids. It is suitable for all municipal and industrial uses.

6. Fort Smith discharges untreated waste into the Arkansas River at the present time; however, two sewage treatment facilities are now under construction. One will provide secondary treatmen.. The other will initially provide primary treatment with future expansion to include secondary treatment.

Conclusions

1. The study area is expected to grow to a total population of 475,000 by 2025 and 900,000 by 2075. The population that is expected to be served by water resources in the Poteau River basin is expected to be 130,000 in 2025, and 230,000 by the year 2075.

2. Projections to the year 2025 indicate a municipal and industrial water requirement to be served from the Poteau River basin amounting to 59.7 mgd, increasing to 84.6 mgd by 2075. This need can be met by providing additional storage in Wister Reservoir to increase its dependable yield by 47.0 mgd, and including storage in Brazil Creek Reservoir to provide a dependable yield of 22.6 mgd. The existing Wister Reservoir, municipal lakes, and Soil Conservation Service projects provide a firm yield of 15.0 mgd.

3. Storage is needed in the enlarged Wister Reservoir for water quality control on the Poteau River. Storage to yield 24,500 acre-feet per year (21.9 mgd) is needed by 2025, and by 2075, this need will increase to 33,000 acre-feet per year (29.5 mgd).

4. The minimum value of benefits attributable to the provision of storage to yield 47.0 mgd from Wister Reservoir, and 22.6 mgd from Brazil Creek Reservoir is estimated to be $222,200 annually, based on the cost of the most likely alternatives.

5. The average annual benefit of storage for water quality control to provide a yield of 33,000 acre-feet per year in the enlarged Wister Reservoir is estimated to be $289,100 on the basis of the cost of the most likely alternate in absence of the project. In addition, water quality releases would increase sport fishing by about 3,000 man-days annually.

6. Benefits attributable to storage for water quality control in Wister Reservoir are considered to be widespread in scope and are based on the provision of adequate treatment of wastes discharged to affected stream reaches.

III. PROJECT DESCRIPTION

The projects under consideration are the enlargement of Wister Reservoir for water supply and water quality storage, and the construction of Brazil Reservoir, located on Brazil Creek, as a multipurpose reservoir for flood control, conservation, and recreation. The location of these two projects is shown on figure III-1, following page X-2.

Pertinent Data

Wister Reservoir

Location	Poteau River, River mile 60.9	
Drainage Area	993 square miles	
Storage, acre-feet	Existing Project	Proposed Enlarged Project
Flood Control	400,000	435,000
Conservation	17,500	73,000
Inactive	12,500	30,000
Total	430,000	538,000
Yield, mgd		
Water Supply	6	53
Water Quality Control	0	29.5

Brazil Reservoir

Location	Brazil Creek, River mile 8.0
Drainage Area	199 square miles
Storage, acre-feet	
Flood Control	85,000
Conservation	22,000
Inactive	5,000
Total	112,000
Water Supply Yield, mgd	22.6

Source: Corps of Engineers 1/

IV. STUDY AREA DESCRIPTION

Location and Boundaries

The study area consists of seven counties located in west-central Arkansas and east-central Oklahoma as shown in figure III-1. The area can be characterized economically as the Fort Smith trade area. It includes Sequoyah, Haskell, Latimer, and LeFlore Counties in Oklahoma and Crawford, Sebastian, and Scott Counties in Arkansas.

Characteristics

The Poteau River basin is characterized by forested mountains and fertile valleys. Approximately two-thirds of the Poteau River watershed is forested. Nonforested land areas are generally in pasture with approximately 6 percent of the total land area in crop production. 2/

The area has a mild climate. Rainfall is adequate for agriculture, ranging from a annual mean rainfall of 50 inches per year in the southern region to 42 inches per year in the northern region. 3/

Average annual runoff from precipitation in the area ranges from 10 to 20 inches per year. 2/ Most of the area's water needs are met by surface supplies. Ground water is scarce in the Poteau River basin and may be considered of little consequence for present or future water needs.

Fort Smith, Arkansas, is the hub of economic activity in the study area. Its population has grown from 31,000 in 1930 to approximately 63,000* in 1962. The smaller municipalities in the study area have grown at lesser rates. In Oklahoma, Poteau, Heavener, Wilburton, Spiro, Panama, and Arkoma are the towns most likely to play an expanding role in the study area economy. Fort Smith, Van Buren, Waldron, Alma, and Greenwood are the more important cities in Arkansas.

---

* Special Census, June 1962, U. S. Bureau of the Census.

V. WATER RESOURCES OF THE STUDY AREA

The Arkansas River, which flows through the study area, has an average annual discharge of 30,910 cubic feet per second at Van Buren, Arkansas. 4/ The dissolved solids concentration of the water averages over 500 mg/l and sometimes exceeds 1,000 mg/l during low flows. Thus, the Arkansas River is not utilized for municipal and industrial water supplies where other supplies of better quality water can be secured, such as from the Poteau River, Lee Creek, and Frog Bayou basins.

Two reservoirs on Frog Bayou, Lake Fort Smith and Lake Shepherd Springs, as shown on figure III-1, supply Fort Smith and intervening communities with municipal and industrial water.

Pine Mountain Reservoir, an authorized Corps of Engineers multi-purpose reservoir on Lee Creek, will store water for flood control, recreation, and water supply for the city of Fort Smith and surrounding communities. Lee Creek, near Van Buren, has an annual average discharge of 459 cubic feet per second. 4/

Wister Reservoir, located on the Poteau River at river mile 60.9, is the only reservoir of major size in the Poteau River basin. Completed in 1949, Wister Reservoir was originally constructed for flood control and recreation purposes only. Recently, however, storage to yield six million gallons per day has been allocated for municipal water use. Original and proposed allocations of storage in Wister Reservoir are shown on table III-1.

There are several municipal reservoirs in the Poteau River basin yielding up to 0.5 mgd for municipal water supply. In addition, two authorized Soil Conservation Service reservoirs near Wilburton, Oklahoma, and Waldron, Arkansas, have allocated storage to meet local municipal water requirements.

Streamflow

The Poteau River flows westward from its source near Waldron, Arkansas, to Heavener, Oklahoma, where it turns north to join the Arkansas River at Fort Smith, Arkansas, river mile 362.0. It drains a total area of 1,888 square miles over its 138 mile length. The main tributaries of the Poteau River are Fourche Maline, drainage area 411 square miles, Brazil Creek, drainage area 234 square miles, and James Fork, drainage area 201 square miles. 5/

Streamflow records on Fourche Maline near Red Oak, Oklahoma, indicate an annual average discharge of 123 cubic feet per second, with extremes ranging from zero to 41,500 cfs. 4/

The Poteau River at Cauthron, Arkansas, has an average annual flow of 211 cfs, with a minimum of zero and a maximum of 32,200 cfs. [4/]

The average annual flow of the Poteau River near Wister, Oklahoma, immediately below Wister Reservoir, is 1,122 cubic feet per second, over the period 1938 to 1964. [4/] This flow has been regulated by Wister Reservoir since October 1949. Figure V-1 shows the annual mean flow frequency of the Poteau River at this gage. The streamflow of the Poteau River is marked by wide seasonal fluctuations. The median monthly flow as a percent of the total annual flow on the Poteau River below Wister Reservoir is shown in figure V-2. Seventy-five percent of the total annual flow can be expected during the four months of February through May, while only five percent of the annual total occurs during the five month period July through November.

Streamflow Quality

The quality of water in the Poteau River basin is of exceptional quality and suitable for municipal and industrial use. Available analyses reveal that the major chemical constituents are well below the Public Health Service Drinking Water Standards as shown in table V-1.

Table V-1

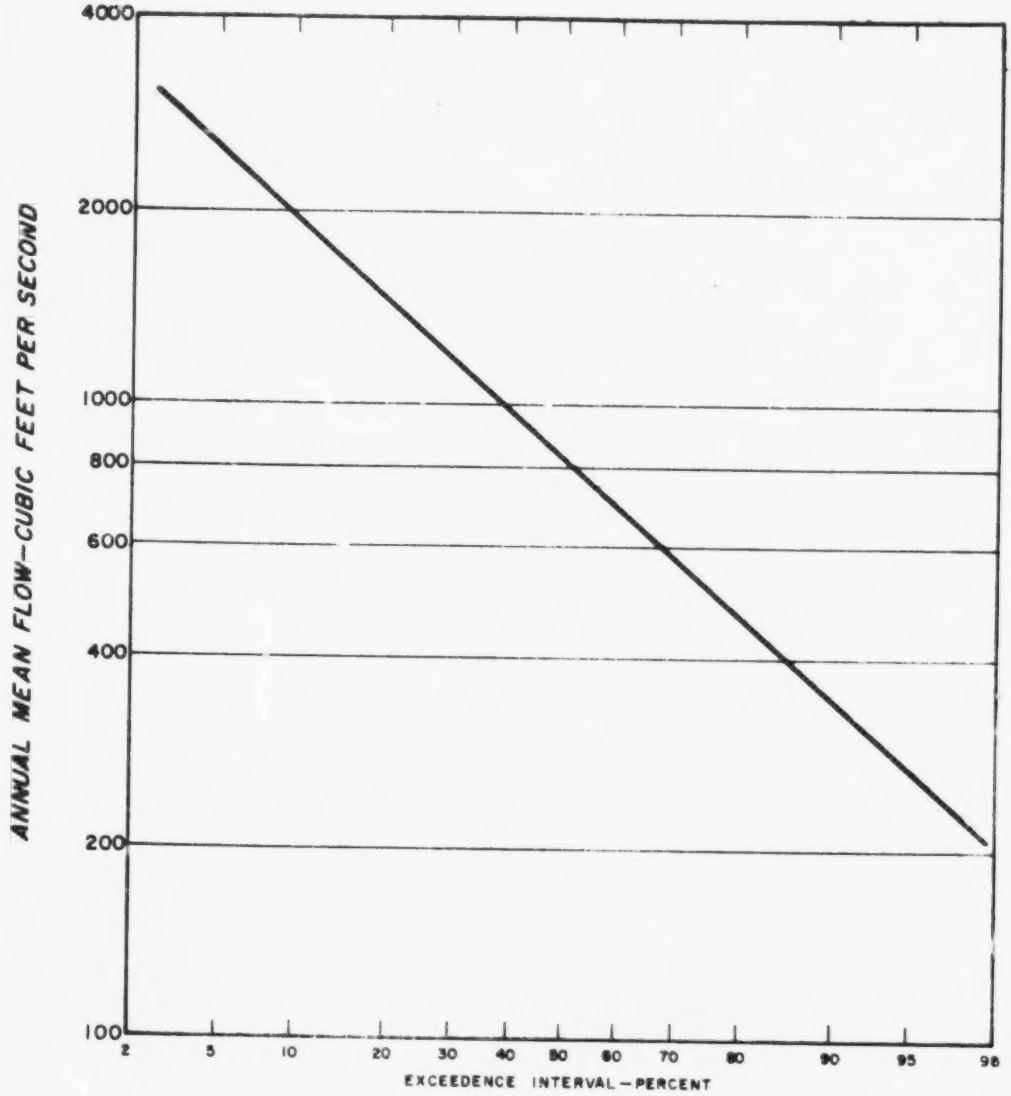
Chemical Analysis

Poteau River Basin
(mg/l)

	Chloride	Sulfate	Hardness (as $CaCO_3$)	Dissolved Solid
Poteau River at Cauthron	4	7	17	53
Poteau River at Wister Reservoir	4	10	19	53
Public Health Service Drinking Water Standards (upper limits)	250	250	-	500

Source: U. S. Geological Survey [6/]

V-2a



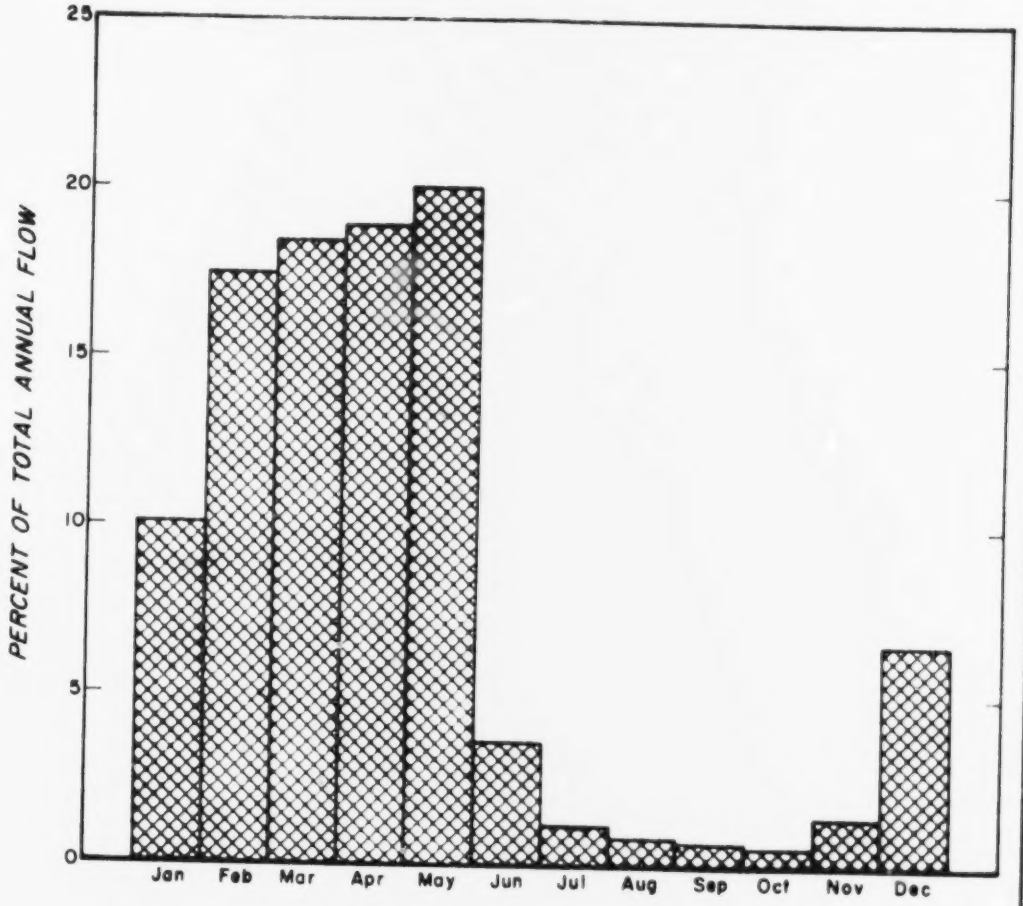
WATER SUPPLY & WATER QUALITY CONTROL STUDY
POTEAU RIVER BASIN — OKLAHOMA & ARKANSAS

ANNUAL MEAN FLOW FREQUENCY
POTEAU RIVER BELOW WISTER RESERVOIR

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
SOUTH CENTRAL REGION Apr. 28, 1966 DALLAS, TEXAS

FIGURE V-1

V-26



WATER SUPPLY & WATER QUALITY CONTROL STUDY
POTEAU RIVER BASIN – OKLAHOMA & ARKANSAS

MONTHLY DISTRIBUTION OF ANNUAL FLOW
POTEAU RIVER BELOW WISTER RESERVOIR

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
SOUTH CENTRAL REGION Apr. 28, 1966 DALLAS, TEXAS

FIGURE V-2

Ground Water

There is very little ground water available in the study area. Only minor use is made of this source of supply and that is mostly individual homes and farms in rural areas.

VI. THE ECONOMY

An economic evaluation was made of the seven-county Poteau study area. The resulting projections of population and industrial growth serve as a basis for estimating future water use requirements and subsequent waste discharges.

Present

Economic Geography

The study area is located in east-central Oklahoma and west-central Arkansas. The Arkansas River runs through the study area from west to east (see figure III-1). The study area essentially could be characterized as the Fort Smith, Arkansas trade area. The study area had a 1960 population of 159,226, as shown in table VI-1. Forty-four percent of these people resided in urban areas. Fort Smith is the largest city in the study area, with a 1960 population of 52,991. A special census which was taken in Fort Smith in 1962 showed a growth to 63,309. The nearly doubling of urban population between 1930 and 1960 failed to offset the loss of about 50,000 people from the rural segment of the economy during the same time period, resulting in a loss of population in the study area for the periods shown. In addition to Fort Smith, other urban population centers include Poteau and Sallisaw, Oklahoma; and Van Buren, Arkansas. In addition to the urban centers listed, the following towns are in the Poteau River water supply area and are considered significant. They are Heavener, Spiro, Panama, Wister, and Wilburton in Oklahoma; and Waldron, Arkansas.

Table VI-1

Study Area Population

	1930	Percent	1940	Percent	1950	Percent	1960	Percent
Urban	39,780	22.3	46,026	23.2	63,707	36.4	69,419	43.6
Rural	138,799	77.7	152,711	76.8	111,331	63.6	89,847	56.4
TOTAL	178,579	100.0	198,737	100.0	175,038	100.0	159,266	100.0

Source: Bureau of the Census 7/

Resources Within the Area

The study area is served by four U.S. highways, numerous State and local highways, and by rail and bus transportation. In addition to the normal transportation forms, the Arkansas River is in the process of being made navigable. This project is scheduled for completion

by 1970. This is expected to be a very significant factor in the future growth of the area.

As previously indicated, much of the population of the study area resides in rural areas. As shown in table VI-2, farm products valued at more than $22 million were sold in the study area in 1959. The value of livestock and livestock products sold was more than 75 percent of the 1959 value. The sale of livestock and livestock products doubled between 1954 and 1959. Vegetables are produced on a commercial scale in the Arkansas Valley, in the area west of Fort Smith.

Table VI-2

Agricultural Statistics for the Study Area
1944 - 1959

	1944	1949	1954	1959
Number of Farms	15,178	13,325	10,953	8,304
Acres of Cropland Harvested	361,930	265,840	221,100	193,860
Value of All Crops Sold*	6,050	4,800	3,770	5,500
Value of All Livestock and Livestock Products Sold*	7,400	7,900	8,800	17,100
Total Value of All Farm Products*	13,450	12,700	12,570	22,600

*All values in 1,000's of 1960 dollars.

Source: Bureau of the Census 8/

Approximately two-thirds of the study area is covered by forest, with the forests consisting of about 55 percent softwood, and 45 percent hardwood. Available yield from the commercial forests are estimated to be about 143 million board feet of softwood, and 43 million board feet of hardwood per year. 9/ Forestry and wood-using industries employed approximately 8½ percent of the labor force of the study area in 1960. Extensive development of these forests has not taken place in the past. The pulp and paper industry, which could provide a market for all types of timber, has not become established in the basin, at least in part, for lack of a dependable supply of high quality water as well as competition from established paper mills in Louisiana and east Texas.

The 1960 value of mineral production was approximately $10 million. 10/ Most of this value was derived from the sale of petroleum and petroleum products. Despite this restricted mineral production activity, there remains within the study area a vast stockpile of raw materials that have a potential for bringing industrial growth to the region. These resources have not played a prominent role in the area's economy in recent years but should be considered in appraising

the future of the basin. In addition to commercial forests, the following resources shown on the resource map, designated figure VI-1, are of present or potential importance: coal, natural gas, and limestone.

Much of the known coal reserves of Oklahoma and Arkansas are located in the study area. The magnitude of mineable coal reserves is difficult to define but most authorities indicate a reserve exceeding one billion tons. 11 12/ Only a fraction of the coal resources of the area has been mined. Mining operations have been limited to the coal that is readily accessible and even these mining operations have been abandoned in recent times.

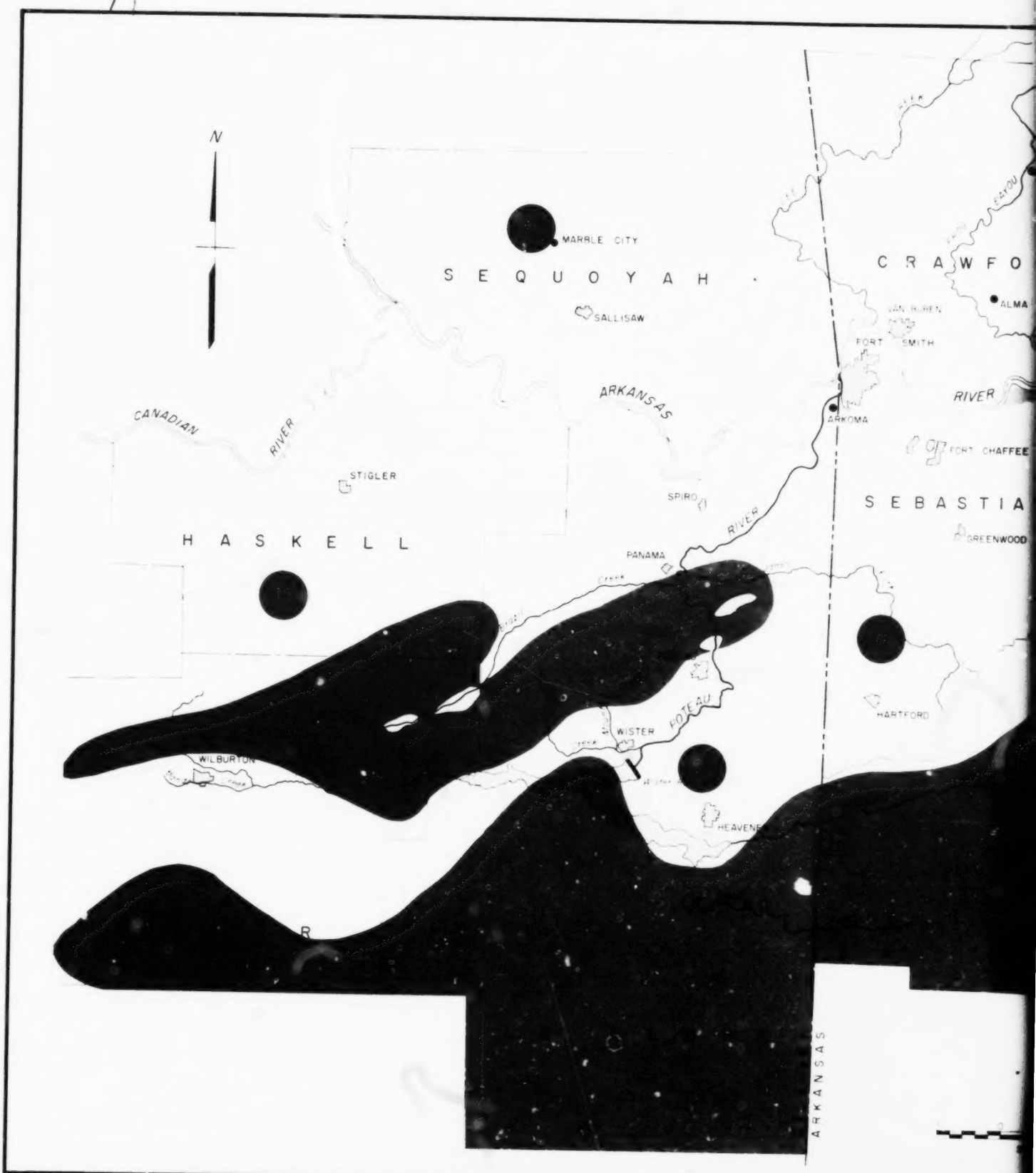
The principal reasons for dormant coal mining activity are unfavorable transportation cost and an unfavorable ratio of production cost to sales value due to the coal being situated in narrow, steep veins.

The reserves of natural gas and natural gas liquids are one of the major assets of the study area because they represent a reliable source of raw materials for petrochemical manufacture as well as a source of fuel. 13/ Geologists have named this area of petroleum reserves the Arkoma basin. The Arkoma basin has been used as a minor supply of natural gas for local consumption for over 50 years and some of the original wells still produce. Several wells that were drilled in the Arkoma basin produced over 30 million cubic feet of gas per day and have been "shut in" for lack of market. 14/ Large reserves of not only natural gas but natural gas liquids, petroleum oil, and asphalt are believed available in the basin awaiting only exploitation. The lack of a market outlet has restricted exploration of the Arkoma basin.

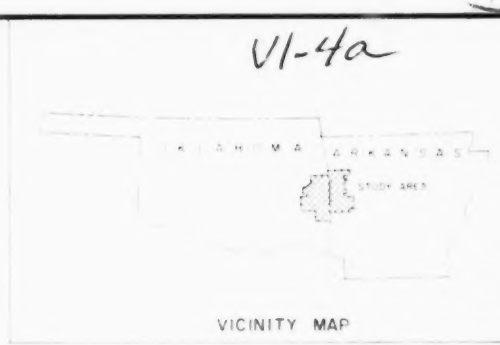
There are numerous supplies of limestone in the United States but not all known reserves are "chemical grade" quality. Such high quality deposits exist in the study area and are presently being mined by a company near Marble City in Sequoyah County, Oklahoma. This company reports it has 36 million tons of limestone analyzing 98.5 percent calcium carbonate and 1.5 percent magnesium carbonate, and 90 million tons at 97 percent calcium carbonate. 15/ These reserves could support a sizeable mining operation for 100 years. In addition to these known reserves, other parts of this same formation are untapped.

Manufacturing

Manufacturing employment has increased from 15 percent of the labor force in 1950 to 21 percent of the labor force in 1960. 16/ Table VI-3 shows that since 1939 the area has experienced a continued growth of new establishments and substantial expenditures of new capital. Major manufacturing industries are food and kindred product processing, lumber, furniture and wood products, and stone, clay, and glass.


N
MARBLE CITY
SEQUOYAH
SALLISAW
CANADIAN
RIVER
ARKANSAS
RIVER
STIGLER
SPIRO
HASKELL
PANAMA
RIVER
WILBURTON
POTEAU
WISTER
HEAVENER
CRAWFO
ALMA
FORT SMITH
ARKOMA
FORT CHAFFEE
SEBASTIA
GREENWOOD
HARTFORD
ARKANSAS

VI-4a



VICINITY MAP

LEGEND

COAL (Coking)

LIMESTONE (Metallurgical)

FOREST (Commercial)

WATER SUPPLY & WATER QUALITY CONTROL STUDY
POTEAU RIVER BASIN — OKLAHOMA & ARKANSAS

RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration

FIGURE VI-1

Table VI-3

Manufacturing Activity in the Study Area
1939 - 1958

Year	Number of Establishments	Value Added*
1939	128	21,200
1947	177	34,500
1954	205	49,000
1958	244	60,500

*1,000's of 1960 dollars.

Source: Bureau of the Census 17/

Future

The history of the development of the Inland Waterway System in the United States has been characterized by the remarkable growth of industry. In practically every case, the projections of tonnage to be moved by barge upon a contemplated waterway have been far exceeded in a relatively short span of time. Thus, the savings in transportation charges have usually more than equalled the long-run costs.

Such a remarkable industrial growth is anticipated in the study area when the navigation of the Arkansas River becomes a reality. The cities and towns in the Poteau River Valley are already making preparation for industrialization. Heavener, Spiro, and Poteau are planning for expansion of their sewerage and water facilities. Other Poteau projects include a new municipal airport, a new high school, and a national museum.

Steel

One of the most significant factors in the future growth of the area will be the development of previously untapped resources. Because of technical advancements, shifts in the prices of fuel, and new markets opened as a result of the navigation of the Arkansas River, the locally available resources of coking coal, metallurgic limestone, and natural gas, plus the relatively unlimited iron ore sources from either northeast Texas, the Pea Ridge of Missouri, or even South America, make the consideration of a raw steel mill in the Fort Smith area an economic possibility.

In the Oklahoma market area, consisting of Oklahoma and the six surrounding states, 10.95 million tons of steel were consumed in 1963. 18/ Fifty-two percent, or 5.7 million tons, of this steel was imported into the area. 18/ As the Oklahoma market area increases in population, the demand for steel and steel products will increase.

This demand, plus the reserves of natural resources, and the development of the water resources of the area, makes the Fort Smith trade area a prime competitor for the location of a steel mill and related industrial complex to serve the Oklahoma market area demand. Two recent studies have reported on the economic feasibility of a steel producing complex in the area, 18 19/ one of which 18/stated that a blast furnace is presently being considered in the Fort Smith area.

Coal

In the past, the cost to the consumer of coal mined in the area has not been competitive with other coal fields primarily for three reasons. These are:

1. High cost of production due to antiquated methods in both strip and underground mining.

2. High transportation costs due mainly to inaccessibility to barge transportation and the consequent loss of distant markets.

3. Lack of a large market, both locally and distant, which would lower unit operating costs as well as unit transporting costs.

Despite the present condition of the coal industry in the area, the future prospects for coal appear to be good. The most promising development is the increasing cost of natural gas used for power generation. The differential cost per British thermal unit (BTU) between natural gas and coal, which historically has greatly favored natural gas, is gradually narrowing. When the cost per BTU of heat for coal equals the cost for natural gas, possibly within the next ten years, the use of coal for power generation will receive a tremendous impetus.

The growth of the steel industry, particularly in the Southwest, will increase the demand for coal for use in coking ovens.

Since the transportation costs are a high percentage of delivered prices of coal, substantial savings by water have the effect of greatly extending the market area for coals in a given field. Typically, barge movement saves about 7 mills per ton mile as compared with rail movement, 15/ although the actual saving depends upon many factors, such as the length of the haul, the loading and unloading conditions, and consistency of movement. On the Ohio River coal hauls, barge rates have run about 50 percent of rail rates, 15/ certainly sufficient to divert large tonnage to barges. The effect for eastern Oklahoma coals will probably be similar.

Petrochemical

The past 30 years has seen the development of the petrochemical industry from virtually nothing to a major position in the industrial economy of the United States. In the past 10 years, the petrochemical industry has grown at the rate of 10 percent per year. The large proportion of the growth in petrochemical production has taken place near the good raw material sources and markets located in the Texas and Louisiana gulf coast area. More than two-thirds of current U.S. total capacity is made in this area. Navigable waterways adjacent to these plants have made it possible to ship much of their production to manufacturing centers of the North and East using low-cost barge transportation. As the petrochemical industry grows, additional plants must be constructed, either at the termini of gas pipelines or at the actual site of hydrocarbon raw materials.

The State of Oklahoma is one of the leading producers of natural gas in the United States, ranking third behind Texas and Louisiana. Oklahoma has such good reserves of natural gas that it would seem logical to establish a new petrochemical plant in the State. Such a plant could be established in the Poteau River basin, to take advantage of the natural resources as well as the barge transportation on the Arkansas River.

Paper

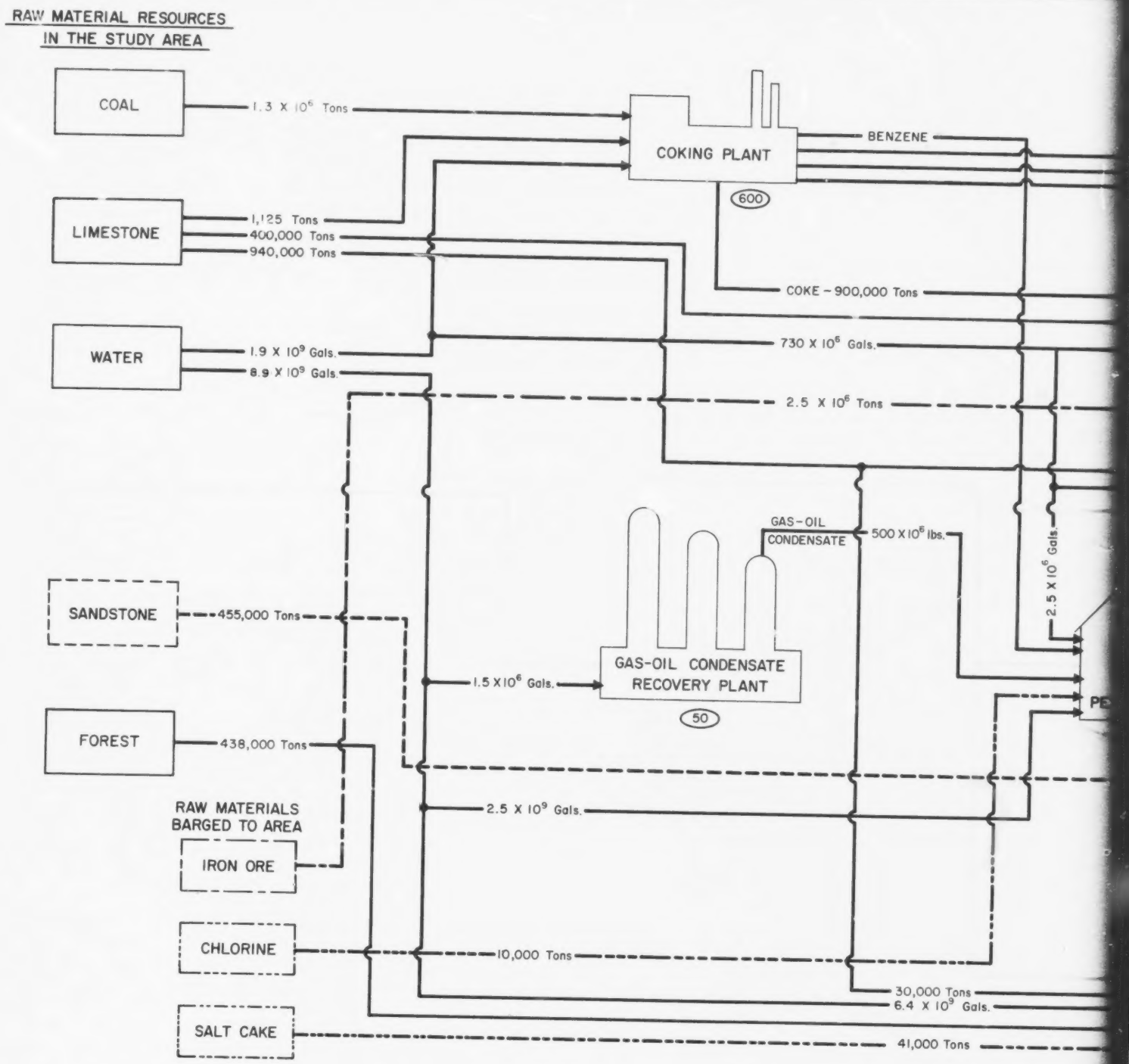
Paper and paperboard are as universally in demand as food. Every consumer uses paper products in some form and every major industry type uses paper or paperboard products in packaging or in the end product. The many uses of wood fiber products and the increasing diversity of users maintains a tremendous demand that will increase per capita consumption in the future.

The large forest resources of the Poteau River basin would make it a probable location of a paper mill once the navigation of the Arkansas River is completed. A mill in this area could serve the rapidly growing industrial markets to the Northwest, West, and Southwest.

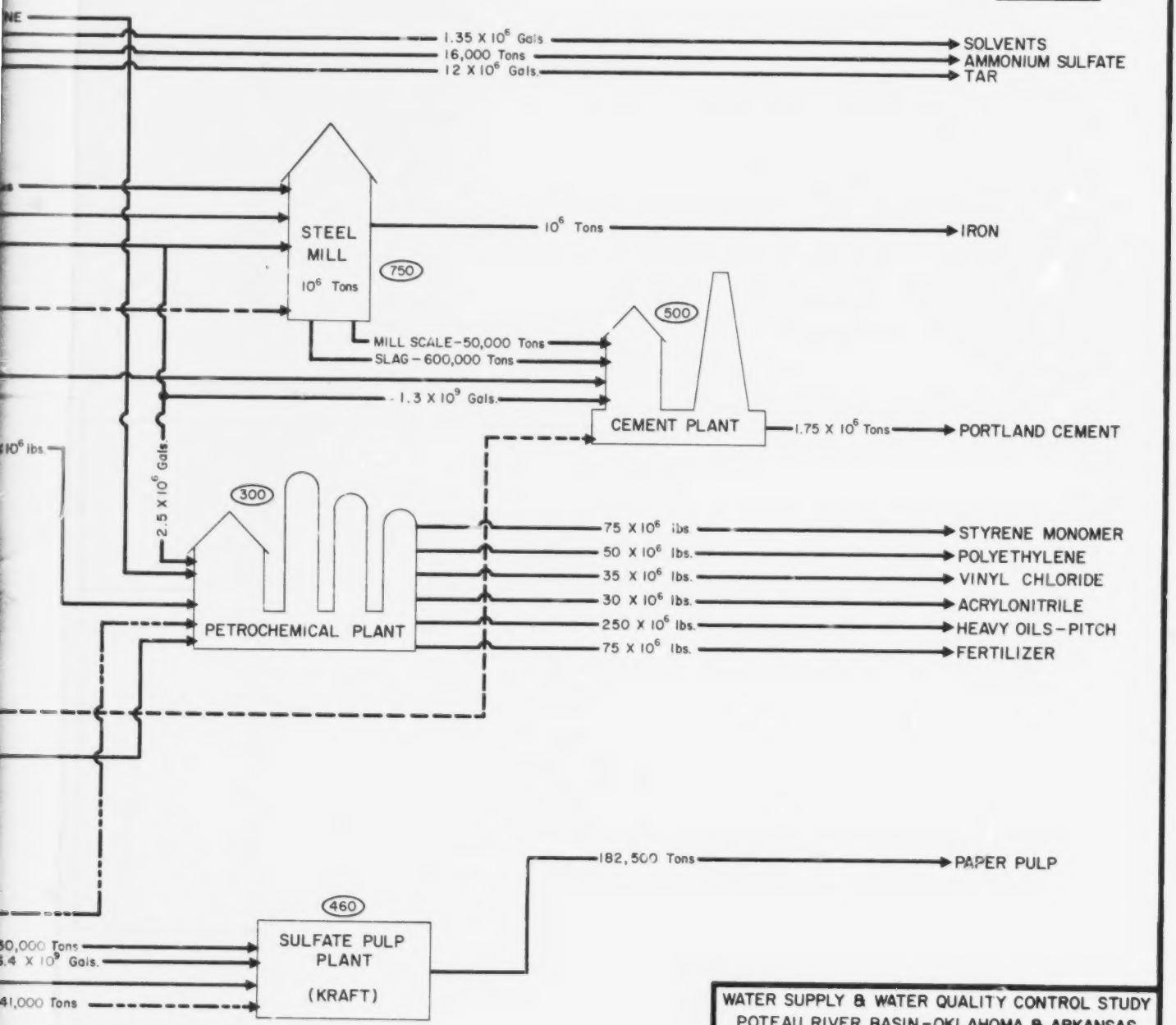
Figure VI-2 illustrates a projected industrial complex for the study area by 2025. The color key for the industrial complex chart corresponds to the color key used in the resource map, figure VI-1. The complex includes a steel mill, estimated at 1 million tons per year, with byproducts from the coking plant being utilized in a petrochemical plant.

Also considered in the size of the petrochemical plant were yields of natural gas and natural gas liquids in the area. A natural gas plant was designed to supply the industries in the basin. Steel mill slag and fly ash are a desirable raw material for cement manufacturing and these byproducts, in addition to local limestone,

A


RAW MATERIAL RESOURCES
IN THE STUDY AREA
COAL
1.3 X 10⁶ Tons
COKING PLANT
BENZENE
600
LIMESTONE
1,125 Tons
400,000 Tons
940,000 Tons
COKE – 900,000 Tons
WATER
1.9 X 10⁹ Gals.
8.9 X 10⁹ Gals.
730 X 10⁶ Gals.
2.5 X 10⁶ Tons
GAS-OIL
CONDENSATE
500 X 10⁶ lbs.
2.5 X 10⁶ Gals.
SANDSTONE
455,000 Tons
1.5 X 10⁶ Gals.
GAS-OIL CONDENSATE
RECOVERY PLANT
50
FOREST
438,000 Tons
2.5 X 10⁹ Gals.
RAW MATERIALS
BARGED TO AREA
IRON ORE
CHLORINE
10,000 Tons
30,000 Tons
6.4 X 10⁹ Gals.
SALT CAKE
41,000 Tons
NOTE
1. (30
2. QU

VI-6a



NOTE

1. (300) EMPLOYEES
2. QUANTITIES GIVEN ARE BASED ON ONE YEAR OPERATION

WATER SUPPLY & WATER QUALITY CONTROL STUDY
POTEAU RIVER BASIN-OKLAHOMA & ARKANSAS

POSSIBLE INDUSTRIAL COMPLEX

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
SOUTH CENTRAL REGION Apr. 25, 1966 DALLAS, TEXAS

FIGURE VI-2

become the basis for design of a cement plant in the basin. A kraft pulp plant completes the industrial complex for the basin.

These industries, plus new employment of satellite industries and expansion of industries presently located within the area, were used as a basis for estimating 2025 employment. Employment projections to the year 2025 appear in table VI-4.

Table VI-4

Study Area Labor Force and Population
1960 and 2025

	1960*		2025	
	Population & Labor Force	% Labor Force	Population & Labor Force	% Labor Force
Agriculture, Forestry & Fisheries	4,178	8.1	3,500	1.9
Mining	811	1.6	7,500	4.1
Manufacturing	10,897	20.9	43,000	23.2
Resource Oriented	8,613	16.5	33,000	17.8
Nonresource Oriented	2,284	4.4	10,000	5.4
Basic Total	15,886	30.6	54,000	29.2
Service	31,746	60.9	121,750	65.8
Unemployed	4,426	8.5	9,250	5.0
Total Labor Force	52,058	100.0	185,000	100.0
Total Population	159,226		475,000	
Labor Force % of Population		32.7		39.0

*Source: Bureau of the Census 16/

From the employment projections, population projections for the study area were derived. Study area population is expected to increase to 475,000 by 2025, with 435,000 residing in urban areas. This is an average annual increase of 1.7 percent between 1960 and 2025 compared to a projected growth of 1.7 percent for the U.S. 20/ The National Planning Association made projections for selected metropolitan areas to 1975. Their projections showed Tulsa, Oklahoma increasing 3.7 percent annually, Wichita, Kansas increasing 4.1 percent annually, and Little Rock, Arkansas increasing 2.7 percent annually. 21/ To provide a framework for analyzing water requirements and waste discharges in the Poteau River area, these projections were disaggregated to the larger towns in the study area. Population projections for the entire study area and that portion of the study area to be effected by the Poteau River project (Latimer and LeFlore Counties, Oklahoma, and Scott County, Arkansas) are shown in table VI-5.

Since the reservoirs proposed in the Poteau River area are expected to have a useful life of at least 100 years, the water requirements and waste discharges as well as benefits have been determined for the 100-year period 1975 to 2075. For the 50-year period, 2025 to 2075, population is used as an indicator of water requirements. As shown in table VI-5, total study area population is expected to reach 900,000 by 2075, with 860,000 residing in urban areas. In the Poteau portion of the study area, the population is expected to reach 150,000 by 2025, and 250,000 by 2075. Because of the location of water supplies and resources, it is expected most of the industrial activity will occur in the Poteau River drainage area between Wister Reservoir and Fort Smith, Arkansas. Much of the growth of the Poteau River area will be a result of outward expansion of the urban population in Fort Smith.

Table VI-5

Population Projections to 2025 and 2075 for the Study Area, the Poteau Area, and Specified Cities
(1,000's)

	1960	2025	2075
Total Study Area			
Urban	69	435	860
Rural	90	40	40
Total	159	475	900
Poteau Area			
Urban	6	130	230
Rural	38	20	20
Total	44	150	250
Poteau Area Cities			
Poteau	4	60	100
Spiro	1	15	30
Panama	1	10	20
Wister	1	5	10
Wilburton	2	15	25
Waldron	2	10	15
Heavener	2	15	30

VII. WATER REQUIREMENTS - MUNICIPAL AND INDUSTRIAL

Past and Present Water Use

There are no heavy water-using industries in the study area; the water demand is, therefore, primarily municipal with small service industry use. In 1963, urban water use in the study area amounted to 10.92 mgd while the water use of all principal communities was about 121 mgd. Water use characteristics of some of the principal communities in the study area are shown in table VII-1.

Table VII-1

1963 Water Use in the Study Area

Municipality	Population Served	Average Use (mgd)	Per Capita Use (gallons/day)	Source
Oklahoma				
Arkoma	1,600	0.10	62	Fort Smith
Heavener	3,005	0.25	83	Black Fork Creek Wister Reservoir
Panama	995	0.10	100	Poteau River
Poteau	6,075	0.37	61	Poteau River Wister Reservoir
Sallisaw	4,100	.32	78	Big Sallisaw Creek
Spiro	1,595	0.17	107	Lake Spiro, 4 Wells
Stigler City	2,850	0.26	91	Stigler Lake
Wilburton	2,400	0.35	146	Fourche Maline
Arkansas				
Alma	1,600	--	--	Fort Smith
Fort Smith	90,000	9.00	100	Lake Fort Smith
Van Buren	3,500	--	--	Fort Smith
Waldron	1,775	--	--	Impoundment

Source: Public Health Service 22/

It can be seen from table VII-1 that per capita water requirements vary from 61 to 146 gallons per day. The daily per capita water demand of urban places is about 109 gallons.

With only minor exceptions, all municipal water supplies are taken from surface sources. However, the great water supply potential of the Poteau River is virtually untapped. There is at present no major water supply reservoirs in the basin to provide a dependable yield during periods of low flow.

Future Requirements

Municipal

Chapter VI points out that the population of the study area is expected to reach 475,000 in 2025 and increase to 900,000 by the year 2075. Of this total, 130,000 will probably be served by municipalities which take their water from the Poteau basin in 2025 and this will increase to 230,000 by the year 2075. The Fort Smith-Van Buren area will be served by existing facilities on Frog Bayou and the authorized Pine Mountain Reservoir on Lee Creek.

Municipal water requirements are based on the per capita demand reaching 150 gallons per day by 2025 and prevailing until 2075. This includes not only water for personal and home use, but water used by service and light industries, and treatment plant and distribution losses.

On this basis, the manicipal water demand to be met from the Poteau River basin is expected to amount to 19.7 mgd in 2025 and 34.6 mgd in the year 2075. Shown in table VII-2 are the municipal water demands, by community, for the years 2025 and 2075, in the Poteau River basin.

Industrial

Provision for municipal and industrial water supply storage in the Poteau River basin will provide the water resources necessary for industrial exploitation of the area's natural resources. Completion of the navigation system on the Arkansas River by 1970 and the availability of dependable reserves of water should provide a stimulus for industrial development in the study area.

Industrial water demands are those to be used by manufacturing and thermoelectric power generation in the area. It is expected that water for these purposes will be taken directly from reservoirs or the streams and treated within the user's plant. Industrial water use estimates are based on expected output and associated unit water use rates. 23, 24/ Data concerning present water use per unit of output were adjusted downward in accordance with current trends in cases where it is known that air-cooling is replacing water cooling, or where it is apparent that water consumption is changing due to more efficient processes. Some heavy water-using industries will be able to use the Arkansas River for cooling water but others will require water of higher quality. Industrial water use projections for the study area are discussed in Chapter VI and presented in figure VI-2.

Table VII-2

2025 and 2075 Municipal Water Demands
Poteau River Communities
(million gallons per day)

Municipality	2025		2075	
	Population	Water Use	Population	Water Use
Poteau	60,000	9.0	100,000	15.0
Spiro	15,000	2.3	30,000	4.5
Panama	10,000	1.5	20,000	3.0
Wister	5,000	0.8	10,000	1.5
Wilburton	15,000	2.3	25,000	3.8
Waldron	10,000	1.5	15,000	2.3
Heavener	15,000	2.3	30,000	4.5
TOTAL	130,000	19.7	230,000	34.6

The projected industrial water demand, by industry, in the Poteau River Basin is presented in table VII-3.

Table VII-3

Industrial Water Use Projections
(million gallons per day)

Industry	2025	2075
Oil and Gas	4.2	5.2
Petrochemical	7.0	8.6
Steel	2.0	2.5
Coke and Coal	1.2	1.5
Pulp and Paper	15.0	18.5
Cement	3.6	4.3
Wood and Wood Products	0.5	0.6
Metals	0.5	0.6
Thermal Electric	5.0	6.2
Food and Kindred	1.0	2.0
TOTAL	40.0	50.0

The total municipal and industrial water supply need in the Poteau River basin in the year 2075 is 84.6 mgd. A plan for satisfying this need is presented in table VII-4.

Table VII-4

Municipal and Industrial Water Supply Plan
(million gallons per day)

2075 Projected Need	Source		
	Wister Reservoir	Brazil Reservoir	Private Reservoirs and SCS Projects
84.6	53.0	22.6	9.0

VIII. WATER QUALITY CONTROL

The Poteau River has many attributes to support municipal and industrial growth. The upper reaches of the basin are situated in mountainous regions that are lightly populated and free from natural pollutants. As shown in table V-1, water quality of the Poteau River basin is of exceptional quality.

A major factor in providing adequate water resources for any sector of the country is the problem of waste disposal. Thorough water planning for an area must include not only adequate water supplies for municipal and industrial users but must also insure that adequate assimilative flows exist in streams which receive treated wastes.

Fort Smith is the principal water-using municipality in the area; consequently, the waste from Fort Smith is of primary concern in water quality control. Historically Fort Smith and Van Buren have used the Arkansas River for disposal of their untreated wastes; at the present time, however, both cities are in the process of providing adequate waste treatment facilities.

Although the Arkansas River is highly mineralized, it has the assimilative capacity to handle a significant quantity of adequately treated municipal and industrial waste. Based on expected return flows in the year 2075, the mean flow of the Arkansas River during the month of lowest flows, at the 98 percent exceedence interval (once in fifty years low annual flow) is several times greater than the minimum quality requirements.

Water Quality Objectives

The objectives of quality control in the Poteau River basin are to maintain a minimum dissolved oxygen concentration of 4.0 mg/l and a dissolved solids concentration of less than 500 mg/l. It is necessary to investigate water quality parameters on a monthly basis as BOD is temperature dependent. Waters in the Poteau River basin, and in fact the waters of the Arkansas River, are certain to be used for a myriad of purposes including water supplies, recreation, and conservation. It is therefore necessary that at least minimum quality objectives be maintained.

There are three locations in the Poteau River basin that will require water for quality control. These requirements are based on the return flows from projected municipal and industrial growth having received adequate treatment to remove 90 percent of the biochemical oxygen demand (BOD) and none of the dissolved solids before being discharged to the receiving streams.

The three locations for which water for quality control is necessary are: the Poteau River below Waldron, Arkansas, the Fourche Maline below Wilburton, Oklahoma, and the Poteau River below Wister Reservoir. Quality control needs in the Poteau River below Wister are controlled both by dissolved oxygen and dissolved solids while the other locations are controlled by dissolved oxygen alone. This results from the expected industrial return flows below Wister Reservoir. The minimum monthly dilution flows needed to control water quality at these three locations are presented in table VIII-1 and VIII-2.

A portion of the gross dilution requirements are contributed by natural runoff. The net additional need, or annual draft-on-storage*, is the difference between the gross dilution needs and the available natural streamflow. This need which is to be supplied by storage is presented in table VIII-3.

Table VIII-3

Net Water Quality Control Draft-on-Storage Need
Poteau River Basin

Location	2025		2075	
	ac-ft/yr	mgd	ac-ft/yr	mgd
Poteau River below Wister Reservoir	24,500	21.9	33,000	29.5
Poteau River below Waldron, Arkansas	590	0.5	960	0.9
Fourche Maline below Wilburton, Oklahoma	750	0.6	1,750	1.6
TOTAL	25,810	23.0	35,710	32.0

The enlarged Wister Reservoir can supply the yield needed below Wister Reservoir for water quality control. Soil Conservation Service projects above Waldron and Wilburton can supply the water quality control needs below these towns.

* Annual draft-on-storage is the sum of the incremental excess of needed releases over inflows during a year.

Table VIII-1

Gross Water Quality Control Requirements
Poteau River Below Wister Reservoir
(mgd)

Month	Temp. °C	2025 Dissolved Oxygen Control	2025 Dissolved Solids Control	2025 Minimum Gross Need	2075 Dissolved Oxygen Control	2075 Dissolved Solids Control	2075 Minimum Gross Need
January	4.5	0	33.5	33.5	0	39.5	39.5
February	6	0	33.5	33.5	0	39.5	39.5
March	11	4.7	33.5	33.5	6.1	39.5	39.5
April	17	17.0	33.5	33.5	22.0	39.5	39.5
May	23	40.1	33.5	40.1	52.0	39.5	52.0
June	26	50.0	33.5	50.0	64.8	39.5	64.8
July	28	58.5	33.5	58.5	75.8	39.5	75.8
August	26	50.0	33.5	50.0	64.8	39.5	64.8
September	23	40.1	33.5	40.1	52.0	39.5	52.0
October	17	17.0	33.5	33.5	22.0	39.5	39.5
November	11	4.7	33.5	33.5	6.1	39.5	39.5
December	6	0	33.5	33.5	0	39.5	39.5
Annual Mean		23.5	33.5	39.4	30.5	39.5	48.8

Table VIII-2

Gross Water Quality Control Requirements
Waldron, Arkansas and Wilburton, Oklahoma
(mgd)

Month	Temperature °C	Poteau River at Waldron, Arkansas		Fourche Maline at Wilburton, Oklahoma	
		2025	2075	2025	2075
January	4.5	0	0	0	0
February	6	0	0.1	0.1	0.2
March	11	0.3	0.4	0.4	0.8
April	17	0.6	0.9	0.9	1.9
May	23	1.3	2.0	2.0	3.9
June	26	1.6	2.4	2.4	4.8
July	28	1.9	2.8	2.8	5.6
August	26	1.6	2.4	2.4	4.8
September	23	1.3	2.0	2.0	3.9
October	17	0.6	0.9	0.9	1.9
November	11	0.3	0.4	0.4	0.8
December	6	0	0.1	0.1	0.2
Annual Mean		0.8	1.2	1.2	2.4

Table VIII-4 presents an estimated monthly release schedule as a percentage of the total annual releases from Wister Reservoir for water quality control. This release schedule is not intended to be used as a reservoir operating plan. Actual releases will be dependent upon streamflow quantity and quality conditions as they occur. Table VIII-4 is being provided only as an indication of a possible release pattern.

Table VIII-4

Water Quality Control Monthly Release Schedule
Wister Reservoir

Month	Percent of Annual Draft-on-Storage
January	4
February	0
March	0
April	0
May	0
June	15
July	21
August	18
September	14
October	11
November	10
December	7

IX. BENEFITS

Municipal and Industrial Water Supply

The benefits of developing the water resources of the Poteau River basin for water supply result from the provision of an adequate and dependable source of water for future population and industrial growth.

A measure of the benefits that can be obtained by including storage for this purpose in the proposed projects can be approximated as the cost of achieving the same results by the most likely alternative means that would be utilized in the absence of the project. Because the municipal and industrial water supply demands are projected to increase greatly in the future, the most likely alternative to the projects under study would be the construction of two large single-purpose water supply storage reservoirs.

The minimum annual value of storage for municipal and industrial water supply in Wister and Brazil Creek Reservoirs would be the sum of the present worth of the most likely alternatives to each project, assuming that water supply storage in Brazil Creek Reservoir was not available until the water demands in the basin exceeded the water supply storage in Wister Reservoir, approximately the year 2025, and discounting the value of storage in Brazil Creek Reservoir from 2025 to the present (1975). It is recognized, however, that water supply storage in Brazil Creek Reservoir would probably be used by nearby communities and industries as soon as it is available, whether or not water supply storage is still available in Wister Reservoir.

The most likely alternate to the enlargement of Wister Reservoir for water supply would be the construction of a single-purpose reservoir on Black Fork. The cost of a single-purpose reservoir, capable of increasing the annual yield of the Poteau River by 47.0 mgd, is estimated to be $4,776,900, including an annual operation and maintenance cost of $30,000, and an annual replacement cost of $200. This initial investment would cost $186,700 annually and would amount to 1.1 cents per thousand gallons of water. This annual cost was calculated by financing at 3 1/8 percent for the 100-year life of the project, as shown in the Appendix.

The value of benefits for water supply storage in Wister Reservoir is approximated as the cost of achieving the most likely alternative, or $186,700 annually.

The most likely alternative to water supply storage in Brazil Creek Reservoir is a single-purpose reservoir on Brazil Creek yielding 22.6 mgd for water supply. The cost of this single-purpose reservoir, would be $4,333,000. As shown in the Appendix, this investment,

financed at 3 1/8 percent over the 100-year life of the project, would cost $172,150 annually, including operation and maintenance. The value of this alternate in the year 2025, capitalizing the annual cost at 3 1/8 percent for 50 years from the year of first need, 2025, to the end of the study period, 2075, would be $4,326,000.

The sequence of building this alternate would begin about 5 years before the time of first need which would allow for planning and construction. Since the time of first use for water supply storage in Brazil Reservoir, based on the total use of the water supply yield of the enlarged Wister Reservoir, has been assumed to be 2025, it is necessary to discount the 2025 value of the alternate from 5 years before that date, or 2020, to the base year of 1975, to determine the present worth of the alternate. The present (1975) worth of the alternate is thus $1,083,000. The annual cost of the most likely alternate to water supply storage in Brazil Reservoir over the 100-year study period is $35,500. The present (1975) benefit of water supply storage in Brazil Reservoir is therefore estimated to be $35,500.

The present minimum annual value of storage for water supply in the basin projects is estimated to be the sum of the present value of the most likely alternates to the projects, or $222,200.

Water Quality Control

Releases from Wister Reservoir to maintain quality in the Poteau River will benefit the entire population of the study area by providing recreational opportunities along the Poteau River as well as assuring the industries and communities which use Poteau River for water supply of a dependable source of good quality water.

Without adequate dilution flows, the projected municipal and industrial waste returns will contain sufficient biochemical oxygen demand (BOD), even after treatment, to deplete the dissolved oxygen in the stream during periods of low flow. Under such conditions, fish life would leave the area or be trapped to die from lack of oxygen. The stream could at times approach a septic condition, become the source of odors, and be a danger to the public health.

The high concentration of dissolved solids in the return flows from the industries expected in the basin will greatly increase the dissolved solids in the Poteau River. This concentration will exceed 800 mg/l at times during low flow periods if sustained flows are not assured. This would adversely affect the utilization of the Poteau River for municipal wate. supplies and some industrial processes which require high quality water.

Senate Document No. 97 defines water quality control benefits as "the net contribution to public health, safety, economy, and effectiveness in use and enjoyment of water for all purposes which are subject to detriment or betterment by virtue of change in water quality." Benefits should be appraised for each purpose where possible but in situations where no adequate means can be devised to evaluate directly the economic effects of water quality improvements, the cost of achieving the same results by the most likely alternative may be used as an approximation of value.

One alternate considered was the construction of a common sewer serving the municipalities and industries located along the Poteau River which would collect the sewage return flows and carry them to the Arkansas River, where sufficient flows exist to assimilate the wastes. However, because of the large size and length of sewer pipes needed, this alternate would be more expensive than the second alternate considered as shown in the appendix.

The most likely alternative to water quality storage in Wister Reservoir would be a single-purpose reservoir on Black Fork to yield 33,000 acre-feet per year (29.5 mgd) draft-on-storage. The first cost of this alternate would be $7,222,200. Converting these costs to equivalent annual costs using a project life of 100-years and an interest rate of 3 1/8 percent, as shown in the appendix, the total annual cost of this alternate would be $289,100, including an annual operation and maintenance cost of $52,000, and replacement cost of $500 annually.

The value of benefits for water quality storage in Wister Reservoir by the alternate cost method, is $289,100 annually.

In addition, fishing benefits could be attributed to water quality control releases in the river. These releases would provide the greatest benefits in the reach of the river downstream from the city of Poteau. It is estimated that sport fishing would increase to about 5,000 man-days annually, of which 3,000 man-days could be attributed to the releases for water quality control. 25/

Since water quality control management of the Poteau River by Wister Reservoir would benefit the entire study area population, projected to be 900,000 by 2075, by providing recreational opportunities, and assure the municipalities and industries using the Poteau River for water supply of a good quality water, benefits from water quality storage are considered widespread in scope.

X. BIBLIOGRAPHY

1. Letter from Tulsa Corps of Engineers, 14 January 1966.

2. Soil Conservation Service, Work Plan for Watershed Protection, Flood Prevention, and Municipal Water Supply, Poteau River Watershed, Scott County, Arkansas, and LeFlore County, Oklahoma, March 1963.

3. Bureau of Water Resources Research, Water, Oklahoma's Number One Problem, University of Oklahoma, Norman, Oklahoma.

4. U.S. Geological Survey, Surface Water Records of Oklahoma, 1964, Department of the Interior. .

5. Drainage Area Data, Arkansas White and Red River Basins, Compiled by Corps of Engineers, Tulsa District, April 1964.

6. Geological Survey, Department of the Interior, Quality of Surface Waters of the United States, Parts 7 & 8, Lower Mississippi River Basin and Western Gulf of Mexico Basin, 1951-1962.

7. Bureau of the Census, Census of Population, 1930, 1940, 1950 and 1960, Washington, Government Printing Office.

8. Bureau of the Census, U. S. Census of Agriculture, for years 1949 and 1959, Part 25, Volume 1, "Oklahoma Counties and State Economic Areas," Washington, Government Printing Office.

9. Letter from John T. Koen, Forest Supervisor, U. S. Department of Agriculture, Forest Service, Heavener, Oklahoma, dated October 5, 1962.

10. Bureau of Mines, Minerals Yearbook for year 1961, Volume III, "Area Reports," Washington, Government Printing Office.

11. A preliminary report on the possibilities of coal development for Eastern Oklahoma by Arthur D. Little and Associates.

12. McDaniel, Gary, "Surface Stratography of the Harts orne Formation, LeFlore, Latimer, and Pittsburgh Counties, Oklahoma."

13. University of Oklahoma, Project HOW, Harnessing Oklahoma's Water, Action Conference, Norman, Oklahoma, 1958.

14. Branan, C.B., Jr., and Jordan, Louise, "Recent Exploration in the Arkoma Basin and Ouachita Province, Southeastern Oklahoma," Oklahoma Geology Notes, October 1959.

15. "Navigation and Water Supply Studies, Southeast and Central Oklahoma," paper presented to the Tulsa District, Corps of Engineers, at McAlester, Oklahoma, March 27, 1962 on behalf of Water Development Foundation of Oklahoma, Incorporated by TEC-Search, Incorporated, Evanston, Illinois.

16. Bureau of the Census, 1960 Census of Population, "General Social, and Economic Characteristics of the Population, Washington, Government Printing Office, 1961.

17. Bureau of the Census, Census of Manufacture, for years 1947, 1954, 1958, Washington, Government Printing Office.

18. "The Economic Feasibility of an Iron and Steel Industry in Oklahoma", Studies in Business and Economics, Number Fifty-Seven, Bureau of Business Research, College of Business Administration, University of Oklahoma, Norman, Oklahoma, March 1965.

19. "The Central Oklahoma Waterway: Feasibility and Economic Benefits", TEC-Search, Inc., Evanston, Illinois, 1963.

20. Economic Task Group of the AD HOC Water Resources Council Staff, National Economic Growth Projections, 1980, 2000, and 2020, July 1963.

21. Economic and Demographic Projections for Eighty-Two Metropolitan Areas, National Planning Association Center for Economic Projections, Report No. 66-R-1, Washington, D.C., May 1966.

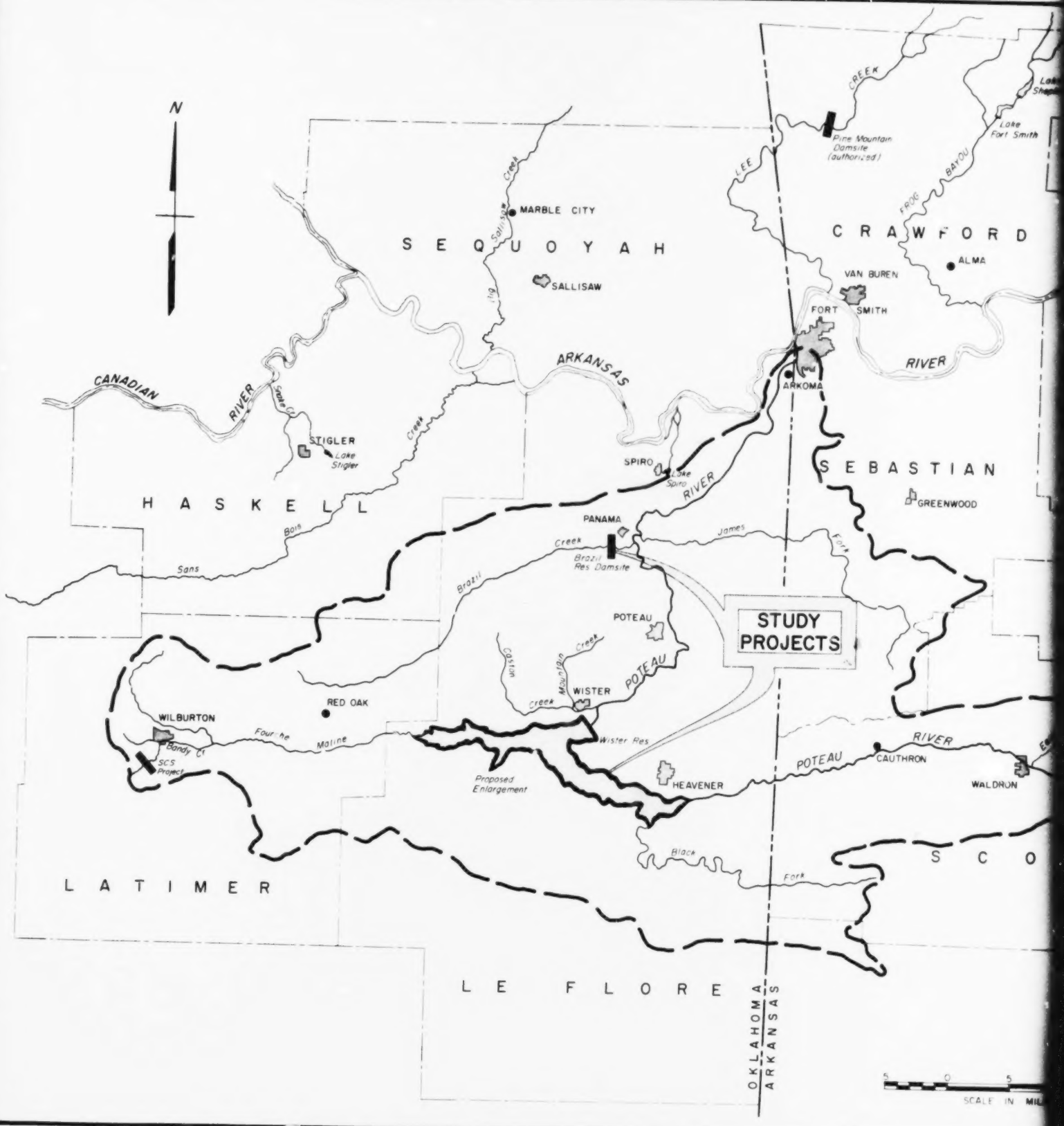
22. 1963 Inventory, Municipal Water Facilities, Region VII, U. S. Department of Health, Education, and Welfare, Public Health Service.

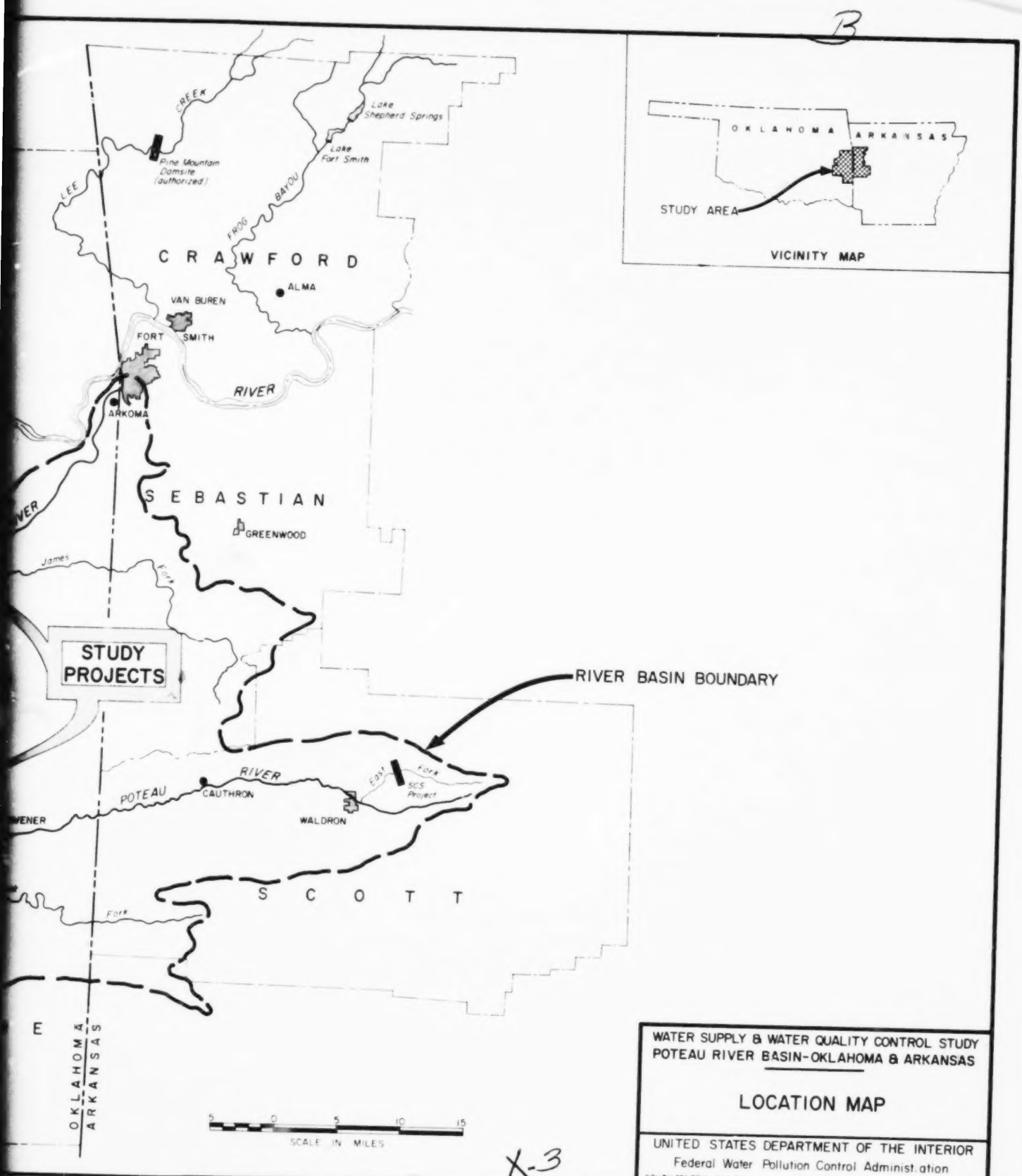
23. Shreve, R. Norris, Chemical Process Industries, New York, McGraw Hill, 1956.

24. Arkerman, E. A., and Lof, G. O., Technology in American Water Development, Baltimore, Johns Hopkins Press, 1959.

25. Letter from Fish and Wildlife Service, U.S. Department of the Interior, Albuquerque, dated August 26, 1966.

A


N
MARBLE CITY
SEQUOYAH
SALLISAW
CRAWFORD
ALMA
VAN BUREN
FORT SMITH
ARKOMA
Pine Mountain Damsite (authorized)
Lake Fort Smith
LEE CREEK
FROG BAYOU
ARKANSAS RIVER
CANADIAN RIVER
STIGLER
Lake Stigler
SPIRO
Lake Spiro
SEBASTIAN
GREENWOOD
HASKELL
PANAMA
Brazil Res. Damsite
Brazil
Sans Bois Creek
James Fork
STUDY PROJECTS
POTEAU
Cavanal Mountain Creek
WISTER
POTEAU RIVER
RED OAK
WILBURTON
Bandy Cr
SCS Project
Fourche Maline
Wister Res
Proposed Enlargement
HEAVENER
CAUTHRON
WALDRON
Black Fork
LATIMER
LE FLORE
OKLAHOMA
ARKANSAS
SCALE IN MI



WATER SUPPLY & WATER QUALITY CONTROL STUDY
POTEAU RIVER BASIN-OKLAHOMA & ARKANSAS

LOCATION MAP

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
SOUTH CENTRAL REGION Apr 25, 1966 DALLAS, TEXAS
Rev Jul 5, 1966

FIGURE III-1

APPENDIX

Summary of Alternative Cost Computations

I. Water Supply Alternates

1. Alternate to water supply storage in Wister Reservoir yielding 47.0 mgd.

Most likely alternate is a single-purpose water supply reservoir on Black Fork Creek with storage to yield 47.0 mgd.

First Cost	$4,776,900*
Annual Cost:	
Amortize First Cost for 100 years @ 3 1/8 percent	$ 156,500
Operation and Maintenance	30,000
Replacement	200
TOTAL	$ 186,700

2. Alternate to water supply storage in Brazil Reservoir yielding 22.6 mgd.

Most likely alternate is a single-purpose water supply reservoir on Brazil Creek yielding 22.6 mgd.

Year of first need = 2025

First Cost	$4,333,000
Annual Cost:	
Amortize First Cost for 100 years @ 3 1/8 percent	$ 141,950
Operation and Maintenance	30,000
Replacement	200
TOTAL	$ 172,150

*Construction costs, annual operation and maintenance costs, and annual replacement costs for single-purpose alternates provided by the Tulsa District, U.S. Army Corps of Engineers.

Revised October 12, 1966

Annual Cost capitalized for 50 years (2025-2075) @ 3 1/8 percent	$4,326,000
Capitalized Annual Cost discounted from 2020 to 1975	$1,083,000
Present (1975) cost of alternate	$1,083,000
Present (1975) Annual Cost of alternate:	
Amortize present cost for 100 years @ 3 1/8 percent	$ 35,500
Present annual benefits of water supply storage in the proposed projects:	
Wister Reservoir	$ 186,700
Brazil Creek Reservoir	35,500
Total annual benefit from projects	$ 222,200

II. Water Quality Control Alternates

Alternate to water quality control storage in the enlarged Wister Reservoir yielding 29.5 mgd for water quality control.

Alternate No. 1

Single-purpose water quality control reservoir on Black Fork Creek yielding 29.5 mgd.

First Cost	$7,222,200
Annual Cost:	
Amortize First Cost for 100-years @ 3 1/8 percent	$ 236,600
Operation and Maintenance	52,000
Replacement	500
TOTAL	$ 289,100

Alternate No. 2

Pipe the treated municipal and industrial effluents to the Arkansas River when sufficient dilution flows exist.

Design Data:
- Pipeline Length - 30 miles
- Drop in elevation - 60 feet
- Flows - 41 cfs in 2000
  60 cfs in 2025
  83 cfs in 2075

Revised October 12, 1966

Design Plan: Construct pipeline at present time to adequately transport waste returns until the year 2000. Add additional capacity at that time.

Pipeline First Cost	
30 miles of 60" R.C.P. in place	$7,539,000
Annual Cost:	
Amortize First Cost for 100-years @ 3 1/8 percent	$ 246,970
Operation and Maintenance	75,390
TOTAL	$ 322,360

This alternate already exceeds the annual cost of the single-purpose reservoir, therefore it is not the least-expensive alternate.